

CLAIMS

1. A transmission apparatus comprising:
 - a plurality of assigning means for assigning
 - 5 independently a plurality of channel data to signal points on a complex plane;
 - a plurality of frequency converting means for converting the frequency of the plurality of signal points output from said plurality of assigning means in
 - 10 response to a center frequency of each channel;
 - a multiplexing means for multiplexing the plurality of signals output from said plurality of frequency converting means;
 - a modulating means for modulating the signal
 - 15 multiplexed by the multiplexing means to an OFDM signal; and
 - a transmitting means for converting the OFDM signal to an RF band signal and transmitting the same.
2. A transmission apparatus as set forth in claim
- 20 1, wherein each assigning means has a mapping means for coding the input information sequence in accordance with a predetermined coding scheme and mapping the same onto signal points of an orthogonal coordinate space of a complex plane defined by an orthogonal I-axis and Q-axis.

3. A transmission apparatus as set forth in claim 2, wherein each mapping means maps said input data in accordance with a QPSK or one of various QAM coding schemes.

5 4. A transmission apparatus as set forth in any one of claims 1 to 3, wherein each frequency converting means converts the frequency according to a phase shift obtained by cumulatively adding a phase-shift angle based on an amount of shift between a center frequency of an RF
10 band signal transmitted by said transmitting means and a center frequency of said channel and a guard interval length.

5. A transmission apparatus as set forth in claim 4, wherein
15 each of said plurality of frequency converting means comprises

a phase-shift angle generator for receiving as input the frequency shift and the guard interval length and generating a phase-shift angle defined by the input
20 frequency shift and the guard interval length and effective symbol duration of an OFDM signal,

an adder for adding a phase-shift angle generated by said phase-shift angle generator and a phase-shift angle preceding one OFDM signal, and

a phase shifter for shifting a phase of the assigned signal from the corresponding assigning means in accordance with the added result from said adder.

6. A transmission apparatus as set forth in claim 5, wherein said phase-shift angle generator generates said phase-shift angle based on the following equation:

$$\text{Phase-shift angle } \theta = 2\pi\Delta f(T+\Delta T)$$

where, Δf is the frequency shift,

ΔT is the guard interval length, and

10 T is the effective symbol duration of the OFDM signal.

7. A transmission apparatus as set forth in claim 6, wherein said phase shifter substitutes a phase-shift θ' input from said adder into the following equation to shift the phase of a signal point of the orthogonal coordinate space of said complex plane input from the assigning means and generate a frequency-converted signal point.

$$\begin{pmatrix} I' \\ Q' \end{pmatrix} = \begin{pmatrix} \cos\theta' & -\sin\theta' \\ \sin\theta' & \cos\theta' \end{pmatrix} \begin{pmatrix} I \\ Q \end{pmatrix}$$

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8. A transmitting method comprising:
an assigning step for assigning a plurality of channel data to signal point on a complex plane;

a frequency converting step for converting the frequency of a plurality of signal points assigned in said assigning step based on a center frequency of each channel;

5 a multiplexing step for multiplexing the plurality of frequency converting signals obtained in said frequency converting step;

a modulating step for modulating the signal multiplexed in the multiplexing step to an OFDM signal;

10 and

a transmitting step for converting the OFDM signal to an RF band signal and transmitting the same.

9. A communication system comprising a transmission apparatus and a receiving apparatus
15 connected wirelessly through a wireless channel, wherein

said transmission apparatus comprises

a plurality of assigning means for respectively and independently assigning a plurality of channel data to signal points on a complex plane,

20 a plurality of frequency converting means for converting the frequency of the plurality of signal points output from said plurality of assigning means in response to a center frequency of each channel,

a multiplexing means for multiplexing the plurality of signals output from said plurality of frequency converting means,

a modulating means for modulating the signal multiplexed by the multiplexing means to an OFDM signal,
5 and

a transmitting means for converting the OFDM signal to an RF band signal and transmitting the same,
and

10 said receiving apparatus comprises

a receiving means for receiving the signal transmitted from the transmitting means of said transmission apparatus;

a frequency converting means for converting the
15 signal received in the receiving means to a signal of an intermediate frequency;

a frequency signal selecting means for extracting from the frequency converted signal only a frequency corresponding to the selected channel;

20 a quadrature demodulating means for quadrature-demodulating the selected frequency signal by using an intermediate frequency signal and extracting an orthogonal I-signal and Q-signal defined in a complex coordinate system;

a demodulating means for demodulating the quadrature-demodulated signal to a time-series signal.

10. A providing medium providing a computer readable program which makes a transmission apparatus
5 execute processing including:

an assigning step for assigning a plurality of channel data to signal points on a complex plane;

a frequency converting step for converting the frequency of the plurality of signal points assigned in
10 said assigning steps based on a center frequency of each channel;

a multiplexing step for multiplexing the signal obtained in said frequency converting step;

a modulating step for modulating the signal
15 multiplexed in the multiplexing step to an OFDM signal;
and

a transmitting step for converting the OFDM signal to an RF band signal and transmitting the same.